IMPROVING THE MANAGEMENT OF OPERATIONS OF THE E-SCOOTER SERVICES IN SICILY: A FIRST STEP OF A DESCRIPTIVE STATISTICAL SURVEY

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Resume
The recent pandemic has changed the modal choices of users in the urban context, highlighting in the last two years an increase in the diffusion of electric scooters, which is not homogeneous in the Italian context. At the beginning of 2020, the first e-scooter services were launched in Sicily, with the city of Palermo leading the way. A survey was therefore conducted in Sicily involving approximately 550 regular users of e-scooter services. The descriptive statistical analysis undertaken compared three different periods pre, during and post pandemic, with particular attention to the gender and age gap and different trends in the diffusion of multimodality. The results provide not only some suggestions for the improvement of services by managers but some suggestions to local administrators for implementation of democratic and sustainable planning steps, as well.

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1 Introduction

The spread of electric micro-mobility is uneven in different European contexts and this is due to several economic, social, and even cultural factors [1]. In general, the use of electric scooters has several advantages. As they are not stuck in traffic, they are a relatively fast means of transport. They also take up little parking space. Unlike cars or motorbikes, they tend not to pollute the air, depending on how the electricity consumption is produced. All these characteristics make them an ideal means of transport. However, they do have some significant disadvantages, the main one being the danger of accidents [2].

The rapid spread of e-scooters in urban areas has emphasized the need to implement urban planning and transport strategies to improve safety when interacting with motorized vehicles and complement active transport modes. In addition, the spread of shared micro-mobility services has enabled different types of users to use electric scooters for single trips or integrated with other modes of transport. It is clear that the management of shared scooter services must strongly consider demand trends and characterization of the users who mainly use these means of transport. This can improve the service and thus increase demand for transport by reducing the use of private motorized vehicles.

While on the one hand, services are on the rise, on the other, there are still many gaps in regulation: in fact, the regulatory and normative aspect is not uniformly widespread and is changing from year to year.

As the use of e-scooters becomes more widespread, the rules throughout the EU are divergent. Conditions of use are regulated at the local and Member State level, and national regulations differ on many important

points. The most important difference is whether the e-scooters are regarded as motor vehicles (e.g. in Ireland) [3], or whether the e-scooter users are regarded as pedestrians using sports or leisure equipment (as in Finland) [4].

In other European states, e.g. in Latvia or Luxembourg, e-scooter users are equated with cyclists [5]. This distinction gives rise to other differences between the national rules, such as in which areas e-scooters are allowed to circulate: on roads, cycle paths or pavements, or whether they are allowed in pedestrian areas, zebra crossings or public places. Other differences between the Member States include, for example, the possession of a driving licence, the registration of the vehicle, or the obligation to take out insurance. The use of protective equipment (e.g. bicycle helmets) also depends on the status of e-scooters, as does the minimum permitted age for drivers, which ranges from 8 years (in France) to 15 years (in Denmark). A study conducted in [5] defined a framework of criteria for the design of a network for scooter traffic, also shared with other modes of transport, and in particular investigated variables such as route continuity, the possibility of route change, appropriate operating speed, and others.

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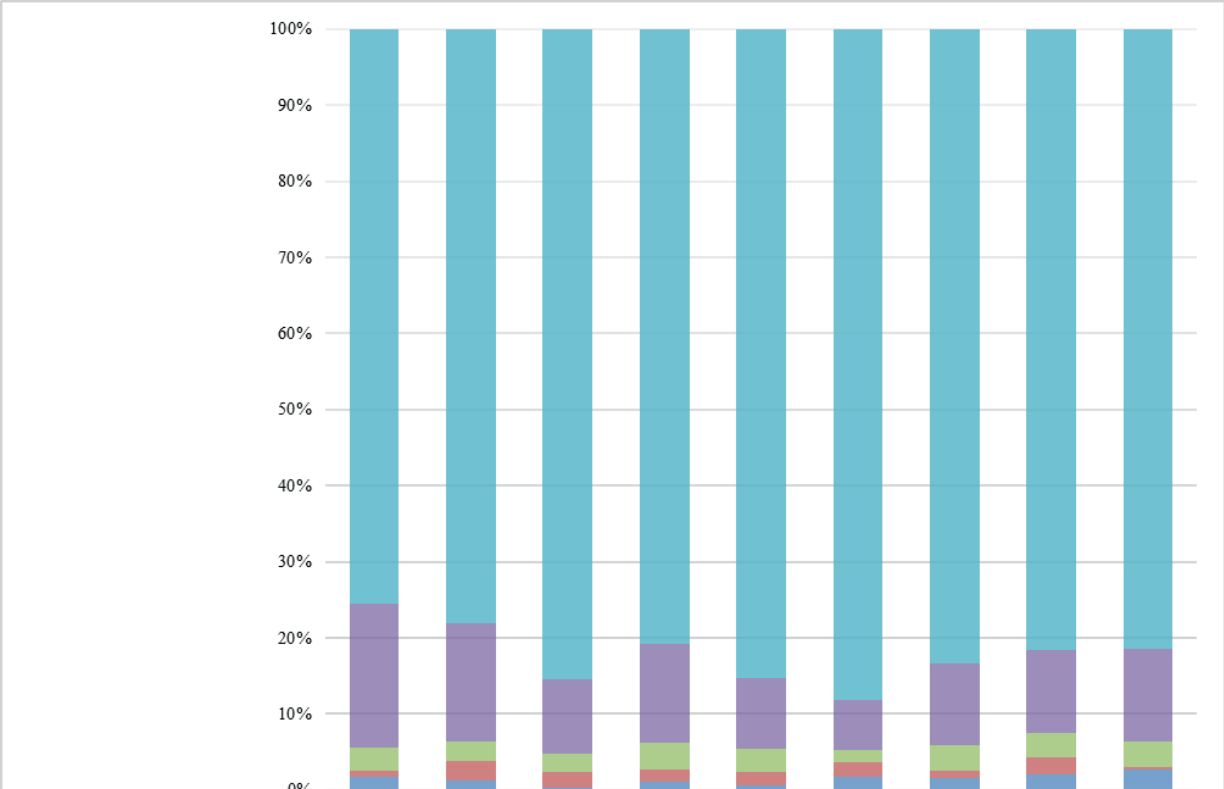
A research conducted in [7] found that drivers of e-scooters are three to five times more likely to be injured than cyclists or motorcyclists. Besides scooterists themselves, they can also injure pedestrians and drivers of other vehicles. Several studies have analysed injuries produced by scooter accidents resulting from the collision of scooters with vehicles and/or other pedestrians [8-9]. The inadequate parking of e-scooters is also an unresolved issue: as there are no specific parking spaces for e-scooters, they are often parked in spaces reserved for cars or bicycles or are abandoned in spaces needed for pedestrians to walk safely. For these reasons, they have already been banned from traffic in some city areas. In other cases, local authorities have reduced their number or periods of use. Several studies have analysed electric scooter (e-scooter) sharing services to investigate their strengths and weaknesses. In particular, the study conducted in [10] considered the situation in the city of Palermo where operators have witnessed a growth in demand in recent months, which has created several critical issues related to vehicle maintenance and vandalism, as well as defined the specific isochrones comparing walking to e-scooter use. The study through a SWOT analysis shows that although the e-scooters tend to be a transport solution with enormous potential, especially in overcrowded cities with increasing private car traffic, several legislative issues also need to be resolved before they can be a real success. Vehicle availability data from 30 European cities during the post-COVID-19 pandemic allowed for comparisons of temporal travel patterns, statistical characteristics (distance and travel time), utilisation efficiency and electricity wastage during the idle period [11]. The results showed that similarities and differences coexist in cities, and the efficiency of use is significantly correlated with the number of e-scooters per person and per unit area. The study conducted in [12] instead examined the different points of view of the operator, policy maker and user with particular reference to the city of Rome, highlighting a pre-competitive phase of the e-scooter sharing market in Italy compared to the United States and Europe, with various differences between cities. Few studies have analysed the integrated use of shared electric scooters and public transport systems, using panel data to measure spatial and temporal characteristics. A study conducted in Chicago by [13] examined the adoption and frequency of use of the shared e-scooters (using a probit model) to provide policy for implementation. The results showed a prevalence of male, low-income users belonging to the Millennials and Generation Z generation who do not own a vehicle.

A study conducted in Vienna analysed the socio-economic profiles and usage patterns of e-scooter users distinguishing between the two basic groups of e-scooter users (renters and owners) and showing that for both groups, e-scooter travel mostly replaces walking and public transport travel whereas the e-scooter owners also show a significant mode shift compared to private car travel [14]. The present work assessed the socio-demographic aspects and usage habits of e-scooters as follows.

2 Background

Modal choices in the post-pandemic phase have diversified with introduction of some services such as shared mobility in several Italian regions. Several studies have recorded almost 18 million rentals in Italy in the last two years. This phenomenon is growing while providing worrying dimensions for the all too often reckless and wild use of users, as well as for the number of accidents that have now surpassed those with scooters (2.07 accidents per 100 thousand kilometres, against 1.72 for mopeds) [15]. In November 2021, the Italian government intervened with a series of changes to the Highway Code precisely to bring order to an increasingly expanding sector: reduction of speed from 25 to 20 kilometres per hour (6 in pedestrian areas); ban on parking on pavements; parking areas to be identified by municipalities; ban on travelling on pavements or against the road and, after the sunset, the obligation to wear reflective vests; prohibition of carrying other passengers, animals and objects and compulsory helmets



	Bologna and Romagna	Florence and Tuscany	Genova and Savona	Milan and Lombardy	Naple and Campania	Palermo and Trapani	Rome and Lazio	Torino and Asti	Venice
Never / Do not exist in my town	75.60%	78.07%	85.48%	80.86%	85.31%	88.11%	83.39%	81.59%	81.42%
Rarely, a few times a year	18.80%	15.60%	9.70%	12.90%	9.30%	6.60%	10.70%	10.90%	12.20%
Occasionally, up to 5 times a month	3.03%	2.53%	2.42%	3.54%	3.09%	1.69%	3.31%	3.21%	3.38%
Frequently, up to 3 times a week	0.90%	2.50%	2.10%	1.60%	1.70%	1.90%	1.10%	2.30%	0.30%
Daily	1.70%	1.30%	0.30%	1.10%	0.60%	1.70%	1.50%	2.00%	2.70%

Figure 1 *Frequency of use of electric scooters in major Italian cities [20]*

for minors, for others only optional. Therefore, if in the past it was the rules that were lacking, today there is a lack of controls with negative consequences for urban road safety.

In 2021, the average rental of electric scooters in Italy was almost twelve minutes, for a distance of 2.3 kilometres. A good figure that testifies to their competitiveness in short distances for which, by now, taking the car is no longer convenient (at least in larger cities) [16].

The metropolitan city of Palermo was the first Sicilian city to have allowed several companies to include electric scooter-sharing services, introducing around 1600 vehicles by 2021 and reaching over 3600 after a few months [17]. The demand for regular users of electric scooters is constantly being analysed. Two studies conducted in [18-19] analysed the propensity to rent, share or buy, while another study analysed the perception of regular users of electric shared mobility services in the city, Figure 1.

Several studies have shown that there is no gender parity in the propensity to use scooters and therefore the demand for mobility can only be strongly characterised by a mostly male component. The study conducted in [21], in the metropolitan cities of Palermo and Catania, revealed the most influential factors on the gender parity variable by emphasising how age, employment and perceived safety level of micro-mobility modes play the most important role. From the point of view of distances that can be travelled, there is no doubt that electric scooters can be useful for short distances or as a complementary means of transport to public transport.

Unfortunately, the city is still far from the “City in 15 minutes” model and this is underlined by a study that compared some 110 European cities [22] and in which the city of Palermo ranks 94th among the cities that come closest to realising this model.

This means that there is still much to be done to reshape Palermo so that it is on a human scale. It is useful to analyse the data provided by platforms of companies that manage these services in the context examined: the platform data show that practically the entire city is not within walking distance in 15 minutes to fulfil all the primary needs of a citizen, apart from the North-South axis of the central area between Liberta and the Central Station. Particularly unserved is the parallel of the previous axis, from Giachery to

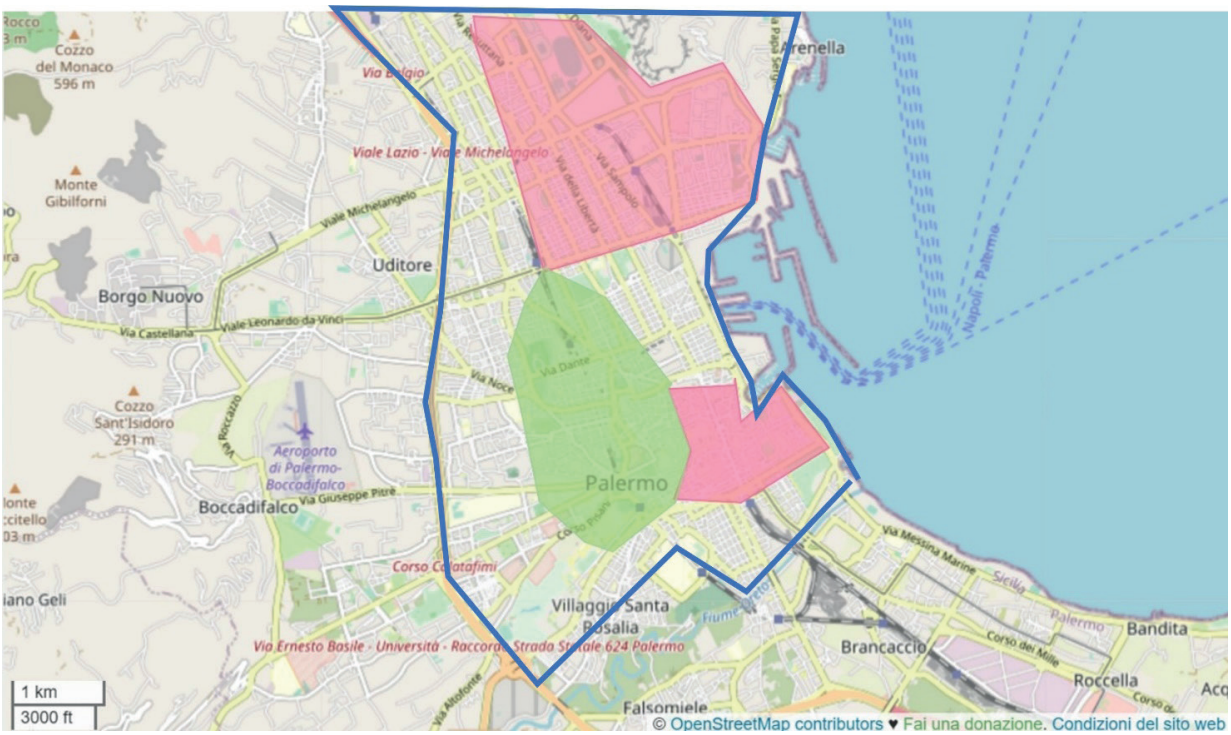


Figure 2 *Geolocation of areas most served by electric scooter services (in green) and least served (in pink) [23]*

the Orto Botanico, Pallavicino, Mondello, Sferracavallo, Zen, La Malfa, Resuttana, San Lorenzo, Borgo Nuovo, Settecannoli, Montegrappa, the Politeama area and Villagrazia, as shown in Figure 2.

Currently the e-scooter rental service is available either in "pay per use" mode, i.e. based on occasional use, paying a certain fee per minute for each rental, or with a subscription. The e-scooters are located in the areas where users leave them and mostly correspond to what is described in Figure 2.

For the electric micro mobility to play an essential role in integrating the city's public transport service and helping citizens to travel more efficiently, it is necessary to analyse the characteristics of demand, i.e. the socio-demographic aspects and the frequency and motivation of travel, also taking into account the trend variations experienced in the different pre- and post-pandemic periods. The following paragraphs describe the steps for implementing and disseminating a survey and analysing the data acquired and the interdependence between some of the variables.

3 Outline of the current operational management of electric micro-mobility services in Italy

The majority of the vehicles on the roads in Italy, however, are private, over 500,000. Approximately 230,000 of them are sold every year, and the trend is steadily increasing [24]. In 2020, despite the lockdowns due to the pandemic, the sector recorded more than 7 million rentals, testifying to the interest of citizens in this new type of mobility, used in urban areas mainly for short journeys instead of cars and as a first/last mile solution for trips interconnected with public transport. The operators for their part have always guaranteed both solid management reliability, with at least 90 % of the authorised fleet available and therefore usable by the citizens, as well as constant investments for example, in upgrading the scooters to technology with interchangeable batteries, in the use of electric vehicles and cargo-bikes for logistics activities, or the experimenting with multi-modality systems, offering the pedal-assisted bicycles or other electric vehicles, as well. Finally, to raise user awareness of sustainable mobility and train them on correct traffic and parking regulations, it should be noted that the operators have organised a total of more than 100 driving courses and other training activities in various cities. Shared micro-mobility vehicles are vehicles that are constantly monitored by the operators.

They are equipped with advanced technology, which by way of example makes it possible to:

- Control speed, limiting it automatically in the selected zone,
- Control parking.

Finally, the number of shared micro-mobility vehicles in Italy is lower than in other European countries, a sign that the conversion to use of the soft mobility means should be further encouraged. Various aspects have been discussed between the operators of electric scooter-sharing services and the Italian Ministry of Infrastructure and Transport since 2021.

Table 1 *Description of the main actions promoting the road safety and improving service*

ROAD SAFETY	REF.	SERVICE IMPROVEMENT	REF.
Definition of complete, organic and permanent regulation to replace the current regime of „experimentation“.	[25]	Dissemination of information on local parking rules provided via app to the user.	[28, 35]
Definition of uniform regulations for e-scooter and bicycles.	[26]	Obligation for the user to take end-of-ride photos to verify proper parking.	[36]
Reduction of the maximum speed limit for scooters, lowering it from 25 km/h to 20 km/h, to reduce potential risks and improve control of the vehicle while driving.	[27]	Invest in more bicycle lanes, possibly in their own lanes, to ensure safe circulation for micro-mobility vehicles.	[37]
Inclusion of in-app information notes for the user for the correct use of the service.	[28]	Plan and design „30 zones“ to increase e-scooter users' safety, as welll as to reduce the speed difference between micro-mobility vehicles and cars when they travel side by side.	[38]
Confirmation of the helmet requirement for minors.	[29]	Activation of a 24-hour customer service by each operator to report badly parked scooters and a dedicated number for the emergency administration.	[39]
Inclusion of mandatory front and rear position lights constantly switched on during the ride.	[30]		
Insertion of the vehicle identification number for vehicles used in the sharing service.	[31]		
Reduction of the environmental impact of fleet renewal.	[32]		
Raising the maximum speed limit in pedestrian areas to 10 km/h (currently 6 km/h) as too low a speed does not allow a sufficiently stable balance to be in full control of a vehicle.	[33]		
Organising awareness campaigns and training activities.	[35]		

Underlying the numerous meetings were discussions on:

- Improving the regulation of scooter services in terms of safety standards and urban decorum in Italian cities,
- Investment in technology to improve services and also reduce operating costs,
- Entrusting the service to companies that can guarantee the highest standards of safety and urban decorum.

The non-standardisation of minimum requirements at the national level for participating in municipal public tenders, allows the service to be awarded without necessarily going through a qualitative examination of the offer of the same.

This lack is remedied, in some cases, through application of the formula “awarding the service in chronological order of dispatch of the application” and not on the qualitative evaluation of the offer.

Several proposals have been put forward by the scooter service operators, regarding the main issues dealt with in Table 1.

To be able to apply a series of actions to improve shared e-scooter services, it is necessary to know what trends users have changed in their travel frequencies and motivations during the last few years and the last pandemic phases. Furthermore, it is fundamental to understand whether certain socio-demographic variables influence these trends to be able to implement targeted policies aimed at developing the shared services analysed.

4 Methodology

The present study was conducted through the creation and administration of an online questionnaire consisting of two sections: the first relating to socio-demographic data and the second to use of electric scooters in different pre- and post-pandemic periods, in particular before 8 March 2020 (the day identified as the start of the pandemic in Italy), during the period May 2020-December 2021 (the period characterised by the post-lockdown period until the discovery of vaccines) and finally from January to May 2022. The questionnaire was circulated from June to September 2022.

The analysis was conducted using an inferential statistical approach and the interdependence of some variables in the first section with those in the second section of the questionnaire was implemented to identify a possible correlation useful for improving the

management of shared transport services in the context examined.

All the variables predicted responses of a single type. Each user took on average less than 10 minutes to fill out the aforementioned questionnaire. After an analysis of the aforementioned data in statistical-descriptive terms, the primary and secondary variables were identified and the presence or absence of a form of interdependence between two sets of variables was analysed.

The probabilistic independence of variables was tested using the Pearson's chi-squared test. The starting formulation of the chi-squared test is defined by:

$$H_0 : P(AB) = P(A)P(B), \quad (1)$$

$$H_1 : P(AB) \neq P(A)P(B). \quad (2)$$

where: H_0 is the null hypothesis;
H_1 is the alternative hypothesis;

A and B are two variables whose independence must be tested.

The equation used to define the χ^2 is:

$$\chi^2 = \sum_{i=1}^{g} \sum_{j=1}^{k} \frac{(n_{ij} - E_{ij})^2}{E_{ij}}, \quad (3)$$

where: n_{ij} is the number of cases observed in sample j and which correspond to the i-th modality;
E_{ij} is the number of cases expected in sample j and for the i-th modality in the case the null hypothesis was true;
g is the number of ways in which the nominal variable is expressed;
k is the number of samples.

The number of expected cases, due to the hypothesis of independence of the samples, is determined as:

$$E_{ij} = \frac{n_{\cdot j} n_i}{n}, \quad (4)$$

where: $n_{\cdot j} = \sum_{i=1}^{g} n_{ij}$ is the numerosity of each of the k samples;

$n_{i\cdot} = \sum_{i=1}^{k} n_{ij}$ is the number of each sample.

5 Results

The sample analysed consisted of 545 units randomly selected through dissemination of the questionnaire on the main social channels (i.e., Facebook).

Table 2 below reveals the statistical data acquired about section 1 .

Likewise for the variables analysed in the second section of the questionnaire as shown in Table 3.

It is therefore denoted that the sample is mostly male with an intermediate adult age between 31 and 50. The typical user is an office worker, however, similarly a freelancer as well, with an average salary of EUR 1001-1500.

As far as vehicle ownership is concerned, the vehicle fleet circulating in Palermo consists of 565,644 vehicles, an increase of 3,088 vehicles (+0.5%) as compared to 2020. Of these, 69.9% are passenger cars, and 22.4% motorbikes. [40].

The results obtained are in line with the characterisation of Italian and European e-scooter user. Concerning the possession of means of transport, almost the entire sample owns a car and about 70% of a bicycle, while a value below 30% identifies the possession of an electric scooter.

In the pre-pandemic period, the electric scooter was mostly used for work-related trips, while in the post-lockdown period, it was used for leisure, and later for both leisure and work purposes. As regards frequency of use, it was a couple of times a week in the first period, rarely in the second period, and once a week in the third period.

These values probably also reflect trends in travel governed by national restrictions and the frequency of use of other transport systems, such as local public transport. Concerning the main use in phases one and two, the predominance of renting is denoted by the predominance of sharing in the third period. This is due

Table 2 *Description of the main variables analysed in the survey (section 1)*

1ST SECTION		
GENDER	AGE	JOB
F (74)(14%)	18-30 (112) (20%)	Student (44) (8%)
M (455)(83%)	31-50 (281) (52%)	Employee (167) (31%)
n.d. (16)(3%)	51-65 (129) (24%)	Freelancer (161) (29%)
	>66 (23) (4%)	Retired (12) (2%)
		Other (161) (30%)
	OWNERSHIP	
E-scooter	Bike	Car
Yes (152) (28%)	Yes (382) (70%)	Yes (535) (98%)
No (393) (72%)	No (163) (30%)	No (10) (2%)
*H-L=Home -Leisure; H-S=Home-School; H-W=Home-Work		

Table 3 *Description of the main variables analysed in the survey (section 2)*

VARIABLES	2ND SECTION		
	1ST PERIOD	2ND PERIOD	3RD PERIOD
Main purpose of e-scooter travel*	H-W (294) (54%) H-S (12) (2%) HL (239) (44%)	H-W (30) (5.5%) H-S (0) (0%) HL (515) (94.5%)	H-W (246) (45.2%) H-S (46) (8.4%) HL (253) (46.4%)
Frequency of travel by e-scooter	rarely (7) (1%) once a week (78) (14%) twice a week (197) (36%) once a day (180) (33%) two or more times a day (83) (16%)	rarely (489) (90%) once a week (36) (7%) twice a week (19) (3%) once a day (1) (0%) two or more times a day (0) (0%)	rarely (39) (7%) once a week (247) (45.5%) twice a week (226) (41.5%) once a day (33) (6%) two or more times a day (0) (0%)
Main use of e-scooter	Own (106) (20%) Rent (439) (80%) Shared (0) (0%)	Own (123) (22.5%) Rent (397) (73%) Shared (25) (4.5%)	Own (75) (14%) Rent (32) (6%) Shared (438) (80%)
Main multimodal use	single use (461) (85%) use integrated with other forms of soft mobility (43) (8%) use integrated with other forms of motorized mobility (41) (7%)	single use (463) (85%) use integrated with other forms of soft mobility (42) (8%) use integrated with other forms of motorized mobility (40) (7%)	single use (72) (13%) use integrated with other forms of soft mobility (418) (77%) use integrated with other forms of motorized mobility (55) (10%)

*H-L=Home -Leisure ; H-S=Home-School; H-W=Home-Work

Table 4 *Interdependency between selected variables and relative results*

	Chi-square value			
	Gender	Significant	Age	Significant
Before	33.8589		79.7715	
During	226.7399	Yes	116.6968	Yes
After	11.4086		99.0143	

to the absence in the first period of shared service and a slow spread from mid-2021 onwards in the examined context. Finally, multimodality was not considered in the first and second periods assuming a single service of scooters from one origin to one destination, instead in the last period the use of scooters was associated with other forms of soft mobility, such as walking for example.

To assess the interdependence of socio-demographic variables with the frequency of travel during the three examined periods, in particular, the age, gender and income variables, present in section 1, were correlated with the frequency present in section 2.

Results are shown in Table 4.

The chi-square calculation, therefore, shows that for the three pandemic periods analysed, there is

an acceptance of the null hypothesis about both the correlation of displacement frequency with gender and age. Therefore, the dependence of the aforementioned variables must be considered to improve the micro-mobility services and implement urban planning actions by local administrations that take into account possible democratic participation in the choices to be made, emphasising measures dedicated to different population groups both by gender and age.

6 Discussion and conclusions

Development of sustainable mobility requires a careful analysis of the demand to be able to provide the best services to users. In recent years, various means of transport sharing services have spread and among these the one of electric scooters is depopulating. As of June 2021, some 42,000 electric scooters were active in Italy, managed by 10 operators in more than 40 cities, in cooperation with the respective municipalities. The sector, mostly formed by innovative start-ups, employs over 2000 people in Italy, mostly young people, and has so far generated local investments of around EUR 50 million, which are, however, at risk if the use of micro-mobility is discouraged.

On the whole, it is a sector that can boast not only results in terms of mobility, but in terms of sustainability as well: one thinks, for example, of the quantities of CO_2 saved during rides, compared to those emitted to cover the same kilometres with a medium-sized car. Finally, to raise user awareness of sustainable mobility and train them on correct traffic and parking regulations, it should be noted that operators have organised a total of over 100 driving courses and other training activities in Italy in various cities.

Shared micro-mobility vehicles are vehicles that are constantly monitored by the operators.

They are equipped with advanced technology, which by way of example makes it possible to:

- Control speed, limiting it automatically in selected zones and
- Control parking with virtual zones where parking is inhibited, forced or encouraged parking controlled through the GPS signal of the users' scooter and mobile phone.

Finally, the number of shared micro-mobility vehicles in Italy is lower than in other European countries, a sign that the conversion to use of the soft mobility means should be further encouraged. Italian regulations are absolutely in line with those of the main European countries, if not even more restrictive, even about the most controversial topics, such as the obligation of helmets, number plates or insurance. The micro-mobility sharing vehicles are constantly monitored by the operators and municipalities and equipped with advanced control systems, as well as by the administrations. All of them are equipped with a GPS and a data card that can constantly detect the position and speed of a vehicle through artificial intelligence systems. In addition, the management system regulates the speed by modulating it, as different zones vary, and parking is also inhibited where expressly prohibited by municipal regulations. All the data can be shared in real-time, anonymised in compliance with the GDPR regulations, to have a constant traceability of mobility flows in the city. In addition, for several months now, various operators have also been implementing various methodologies to monitor the passenger's driving style and to assess his or her psycho-physical state before the start of the ride. Finally, the companies offering sharing services constantly maintain their fleets of vehicles, much more frequently than all other types of private vehicles. All these details show how the evolution of the micro-mobility and improvement of the management of these services can represent an opportunity to test technologies and, at the same time, emphasise the need to know more and more data on users to make the tariffs and the dissemination of these services more efficient. In this way, a series of variables encourage the use of scooters in urban areas, especially for connecting the first and last mile: for example, think of the reduced rental costs, the growing availability of vehicles scattered throughout the different cities, the possibility of having discounts and incentives on purchases, possibility of access in limited traffic areas. While on the one hand the sharing service operators have to consider various strategies to make the use of scooters more appealing, on the other they find themselves having to put up with acts of vandalism and in various contexts even a reduced knowledge of the users' characteristics. Therefore, the present study shows the first step of investigation connected to the spread of scooter services in Sicily, in southern Italy, where dozens of e-scooters sharing service companies have been operating for only a few years. Through the drafting and administration of an online questionnaire it was possible to acquire both socio-demographic variables and variables connected to the frequency and motivation of the move. Particular attention was paid to variation of the usage trends during the various pre- and post-pandemic phases. The data were analysed statistically and particular attention was paid to evaluation of the interdependence of the gender and age variables with variation in the frequency of the scooters' use. The results showed a significance for which interdependence between the respective variables in the three periods was analysed.

The short- and medium-term actions that governments, local administrations and operators in the sector can take to improve these services can be divided into.

Actions to protect road safety, such as the revision of national regulations and municipal limits, or the inclusion of mandatory in-app information notes with a tutorial explaining to the user the most important rules on the correct use of the service. Awareness-

raising campaigns and training activities are also hoped for through a dedicated fund for road education on electric scooters spread by collaboration between each municipality and micro-mobility service operators actions related to urban decorum and dedicated infrastructures by micro-mobility service operators, such as the inclusion of information on local parking rules provided via app to the user and/or the activation of a 24/24 customer service of each operator to report scooters, or even actions by public administrations to invest in the construction of more bicycle lanes, possibly in their own lanes, to ensure safe circulation for micro-mobility vehicles.

The spread of e-scooters, as well as the spread of electric bicycles, in the city of Palermo, and in Italy in general, has increased thanks to state incentives on the purchase and use of shared e-scooters is connected to a service that has been expanding in the city in recent years thanks to the increase in number of companies and therefore the number of e-scooters present in the area examined.

The City of Palermo's bike sharing system allows citizens to use a fleet of public bicycles in a simple and intuitive way. It is a public service and represents a serious alternative to use of private motorised transport, complementing the car sharing service with the advantage of being able to pick up cars and bicycles from the fleet managed by a single company with a single card, in a convenient, healthy and, above all, economical way. It is also useful to underline that while the shared mobility service (cars, bicycles) and public transport is managed by a single company, scooter sharing services are currently connected to different companies that only deal with these services.

It is also necessary to underline that in Italy the use of cars and bicycles is historically characterized by an increase over time throughout the peninsula for cars, and the use of bicycles especially in lowland areas as a means of transport to go to work and not just for leisure. However, the use of electric scooters is recent and the regulations for their use in Italy are not yet complete.

The results shown by this first step of investigation can therefore be implemented to encourage the use of scooters by specific categories of users.

Grants and funding

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Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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